PATENT SPECIFICATION

NO DRAWINGS

Inventor: WALTER HENRY PARRISS

863,679

Date of filing Complete Specification Jan. 20, 1959.

Application Date Feb. 28, 1958. *No. 6578/58.*

Complete Specification Published March 22, 1961.

Index at acceptance: —Classes 87(2), A1R(14C2:39X); and 38(2), T(1F:7C3:10).

International Classification: —B29d, g. H02l.

COMPLETE SPECIFICATION

Improvements relating to Electric Components Embedded in Cast Insulation

We, ASSOCIATED ELECTRICAL INDUSTRIES LIMITED, of 33, Grosvenor Place, London, S.W.1, a British Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to the embedding of an electric component in a body of moulded insulation constituted for instance by one of the so-called casting resins.

In embedding in cast insulation transformer coils or other components tending to have a porous nature, it is a common practice to impregnate such components prior to the casting process. This means, however, that in the case of transformer coils for instance, the coils are substantially incompressible when they are subjected to the casting process and the strains set up in the embedding cast body therefore tend to be higher than would be the case if the coils were resilient.

It would therefore be preferable if the impregnating and casting processes could be done together but if this is attempted with a casting insulation containing a filler of finely divided inert material, the particles of the filler tend to congregate on the external surface of the embedded component and would ultimately seal the surface, so preventing the insulation from reaching the interior regions of the component and effecting a satisfactory impregnation thereof. The desirability of incorporating a filler in the casting insulation, especially for relatively large castings, is well known, the filler serving to modify the coefficient of thermal expansion with consequent reduction of strains, and also to reduce the cost. If a coarse grain filler is used with a view to preventing the surface sealing phenomenon observed with a finely divided filler, it is found that the coarse filler may not remain suspended in the casting insulation while still in its liquid form but tends to settle and leave regions of unfilled insulation.

An object of the present invention is to provide a method by which impregnation and casting can be effected together and a filler incorporated in the casting insulation, without the difficulties mentioned above.

According to the invention an impregnatable component to be embedded in cast insulation is invested *in situ* in a mould with a dry coarse grain filler having a minimum particle size of 300 microns, the mould preferably being vibrated so that all the free space is occupied by the filler; subsequently a casting insulation is introduced into the mould and caused to permeate the filler and impregnate the component as by subjecting the mould to cycles of vacuum and pressure, the insulation being thereafter allowed or caused to set.

The casting insulation employed is preferably one of the so-called casting resins which set to form a void-free body which is substantially infusible. Typical suitable resins are epoxy and polyester casting resins. The nature of the filler, which may be coarse sand, is not important provided that it is insulating, inert and infusible at the highest temperature reached in the embedding process. The particle size is, however, important and a range of particle size from 300 microns to 5000 microns is expected to be satisfactory with a preferred range from 600 to 1500 microns.

In carrying out the invention a component or components to be embedded in a cast body, for instance the high voltage windings of a three phase voltage transformer, are arranged in a suitable mould which may be provided with a reservoir the capacity of which would preferably be sufficient to hold all the casting resin (or other casting insulation) required for the casting and impregnation process. The mould may be contained in a pressure chamber which can be evacua-

[*Price*

ted and pressurised and may include provision for supplying the reservoir without opening the chamber. The complete process may then comprise the steps set out in the following example:—

EXAMPLE

(1) Dry the component or components to be embedded before, or preferably after, arranging them in the mould;

(2) Fill the free space in the mould with coarse grain sand or other such filler having a minimum particle size of 300 microns while vibrating the mould;

(3) Draw a vacuum of, say, less than 10 millimetres of mercury in the pressure chamber;

(4) Supply the reservoir with liquid casting resin at a suitable temperature;

(5) Break the vacuum and pressurise the chamber to a pressure higher than atmospheric, say 80 pounds per square inch;

(6) Repeat the vacuum and pressure cycle at intervals to a total of, say, 2 or 3 vacuum periods and 2 or 3 pressure periods of 30 minutes each;

(7) Cure in a manner appropriate to the resin used.

It is found that this process produces a void-free casting and void-free impregnated coils as required in those applications where the voltage stresses may be sufficiently high to cause electrical discharges to occur in any void that may be present.

WHAT WE CLAIM IS:—

1. A method for embedding an impregnatable electrical component in cast insulation, which consists in investing the component in a mould with a dry coarse grain filler having a minimum particle size of 300 microns, and subsequently introducing into the mould a casting insulation which is caused to permeate the filler and impregnate the component, the insulation being thereafter allowed or caused to set.

2. A method for embedding an impregnatable electrical component in cast insulation comprising the steps of: drying the component and arranging it in a suitable mould; filling the free space in the mould with a coarse grain sand or other filler having a minimum particle size of 300 microns while vibrating the mould; subsequently drawing a vacuum in a pressure chamber containing the mould and supplying the mould with liquid casting resin at a suitable temperature; breaking the vacuum and pressurizing the chamber to a pressure higher than atmosphere; repeating the vacuum and pressure cycle; and curing the resin in a manner appropriate to the particular resin used.

3. A method as claimed in Claim 1 or Claim 2, in which the particle size of the coarse-grain filler employed is from 300 to 500 microns.

4. A method as claimed in Claim 1 or Claim 2, in which the particle size of the coarse-grain filler employed is from 600 to 1500 microns.

5. A method as claimed in any preceding claim, employing an epoxy or polyester resin.

6. A method for embedding an electrical component in cast insulation, substantially as set forth in the example given.

7. An electric component embedded in cast insulation by a method as claimed in any preceding claim.

J. W. RIDDING,
Chartered Patent Agent,
Crown House, Aldwych, London, W.C.2,
Agent for the Applicant.

PROVISIONAL SPECIFICATION

Improvements relating to Electric Components Embedded in Cast Insulation

We, ASSOCIATED ELECTRICAL INDUSTRIES LIMITED, of 33, Grosvenor Place, London, S.W.1, a British Company, do hereby declare this invention to be described in the following statement:—

This invention relates to the embedding of an electric component in a body of moulded insulation constituted for instance by one of the so-called casting resins.

In embedding in cast insulation transformer coils or other components tending to have a porous nature, it is a common practice to impregnate such components prior to the casting process. This means, however, that in the case of transformer coils for instance, the coils are substantially incompressible when they are subjected to the casting process and the strains set up in the embedding cast body therefore tend to be higher than would be the case if the coils were resilient.

It would therefore be preferable if the impregnating and casting processes could be done together but if this is attempted with a casting insulation containing a filler of finely divided inert material, the particles of the filler tend to congregate on the external surface of the embedded component and would ultimately seal the surface, so preventing the insulation from reaching the interior regions of the component and effecting a satisfactory impregnation thereof. The desirability of incorporating a filler in the casting insulation, especially for relatively large castings, is well known, the filler serving to modify the coefficient of thermal expansion with consequent reduction of strains, and also to reduce the cost. If a coarse grain filler were used with a view to preventing the surface sealing phenomenon observed with a finely divided filler, it is found that the coarse filler

may not remain suspended in the casting insulation while still in its liquid form but tend to settle and leave regions of unfilled insulation.

An object of the present invention is to provide a method by which impregnation and casting can be effected together and a filler incorporated in the casting insulation, without the difficulties mentioned above.

According to the invention a component to be embedded in cast insulation is placed in a suitable mould and invested therein with a dry coarse grain filler, the mould preferably being vibrated so that all the free space is occupied by the filler; subsequently a casting insulation is poured into the mould and caused to permeate the filler and impregnate the component as by subjecting the mould to cycles of vacuum and pressure, the insulation being thereafter allowed or caused to set.

The casting insulation employed is preferably one of the so-called casting resins which set to form a void-free body which is substantially infusible. Typical suitable resins are epoxy and polyester casting resins. The nature of the filler, which is preferably coarse sand, is not important provided that it is insulating and inert. The particle size is, however, important and a range of particle size from 300 microns to 5000 microns is expected to be satisfactory with a preferred range from 600 to 1500 microns.

In carrying out the invention a component or components to be embedded in a cast body, for instance the high voltage windings of a three phase voltage transformer, are suitably arranged in a mould which may be provided with a reservoir the capacity of which would preferably be sufficient to hold all the casting resin (or other casting insulation) required for the casting and impregnation process. The mould may be contained in a pressure chamber which can be evacuated and pressurised and may include provision for supplying the reservoir without opening the chamber. The complete process may then comprise the following steps:—

(1) Dry the coils;
(2) Fill the free space in the mould with coarse grain sand or other filler while vibrating the mould;
(3) Draw a vacuum of, say, less than 10 millimetres of mercury in the pressure chamber;
(4) Supply the reservoir with liquid casting resin at a suitable temperature;
(5) Break the vacuum and pressurise the chamber to a pressure higher than atmospheric, say 80 pounds per square inch;
(6) Repeat the vacuum and pressure cycle at intervals to a total of, say, 2 or 3 vacuum periods and 2 or 3 pressure periods of 30 minutes each;
(7) Cure in a manner appropriate to the resin used.

It is found that this process produces a void-free casting and void-free impregnated coils as required in those applications where the voltage stresses may be sufficiently high to cause electrical discharges to occur in any void that may be present.

J. W. RIDDING,
Chartered Patent Agent,
Crown House, Aldwych, London, W.C.2,
Agent for the Applicant.

Leamington Spa: Printed for Her Majesty's Stationery Office, by the Courier Press.—1961
Published at the Patent Office, 25, Southampton Buildings, London, W.C.2, from which copies may be obtained